Edamame Cultivar Response to Ten Herbicide Treatments – 2011

Rick Boydston, USDA-ARS, Prosser, WA

Introduction

Edamame consumption has increased in the U.S. and the majority of the edamame consumed is imported from East Asia. Edamame is considered a nutraceutical food crop, and has many reported health advantages. It is currently consumed as a side vegetable, snack, appetizer, or added to stir-fry vegetables or soups. There is interest from local food processors to grow edamame locally for processing. Edamame is harvested at the R6 stage of soybean growth while the pods are still green and the seed is immature and about 80 to 85% pod fill. Frozen food processors have successfully shelled the pods in the field with equipment used for lima bean harvest.

Pesticides require a legume vegetable tolerance (crop group 6) in order to be added to label for edamame. Although many herbicides are labeled for use on grain soybeans, there are only three herbicide active ingredients labeled for use on edamame, also known as vegetable soybean or immature seed soybean. S-metolachlor, trifluralin, and clethodim are currently labeled on edamame, but in order to grow the crop locally, additional herbicides would be beneficial for weed management in the crop. These studies were conducted to determine the tolerance of six edamame cultivars to several herbicides of interest to local growers and processors. Cultivars and herbicides were selected based on input from four local food processors.

Methods.

A field trial was conducted in 2011 to evaluate the tolerance of six edamame cultivars to ten preemergence and postemergence herbicide treatments. Wanamaker Seeds provided seed of Midori Giant cultivar. WSU Foundation Seed treated Midori Giant, AGS292, WSU729, and WSU910A seed with Max/Cruiser/ApronXL and provided the seed of the last three cultivars, respectively. Sayakomachi and Sayamusumi seed was supplied by NorPac and was treated with Captan/Cruiser/Allegiance. All seed were inoculated with soybean rhizobium at planting.

Edamame was planted 1.5 inches deep in 22 inch rows with a John Deere flex planter on May 23, 2011. Two rows of each of the six cultivars were planted in a strip block design with herbicide treatments as main plots (22 x 25 ft.) and edamame cultivars as split plots (3.7 x 25 ft.). Treatments were replicated four times. The study was located on a Warden sandy loam (O.M. 0.93, pH 6.6) at the WSU-Roza station near Prosser, WA.

Preemergence herbicide treatments were applied May 25, 2011 with a bicycle sprayer delivering 20 GPA through four 8002 XR flat fan nozzles (Table 1). All preemergence treatments included Touchdown (glyphosate) at 1.5 lb ae/a to kill emerged weeds. Edamame emerged June 2, 2011. Edamame stand counts were taken June 13, 2011 prior to postemergence herbicide applications by counting the number

of seedlings from two rows by 2 m long in the center of each plot. Postemergence herbicide treatments were applied June 17, 2011 when edamame had two trifoliate leaves and a third trifoliate just visible.

Crop injury and weed control ratings were recorded at various times following herbicide applications. The final weed control rating was recorded July 6, 2011 and all plots (including weed checks) were hand weeded the remainder of the season. Plant height was recorded August 23, 2011 and green edamame pods were harvested from August 25 through September 12, 2011 as each cultivar reach maturity and pods began to fill (Table 2). All plants were pulled and counted from two rows by 2.3 m long in each plots and the pods removed with a Mitsuwa stationary podder. Pods were weighed and a subsample of 30 pods was removed, weighed and the percentage of one-, two-, three-, and four-seeded pods was determined.

Results.

Annual grasses consisted of a mix of barnyardgrass and green foxtail. Grass control in early July was greatest (97%+) with all treatments containing Dual Magnum applied preemergence (Fig. 3). Grass control with Prowl applied preemergence was 73% in early July and was slightly improved by tank mixing with Reflex or Spartan (Fig. 3). Common lambsquarters was controlled 97% or greater in early July with all herbicide treatments except Dual alone (95%) or Prowl alone (92%) (Fig. 4 and 6). Common mallow control was controlled well with all herbicide treatments except Dual alone (88%) and Dual plus Sonalan (61%). Redroot pigweed was controlled well by all herbicide treatments (data not shown).

Little or no herbicide injury was evident on edamame on June 9 and June 17, 2011 following preemergence herbicide treatments and preemergence herbicide treatments had no significant effect on edamame stand counts taken June 13, 2011 (Fig. 1). AGS 292 cultivar had the lowest stand counts (24 plants/4 m row) followed by WSU 910A (30 plants/4 m row). WSU 729 averaged the highest stand counts (41 plants/4 m row) (Fig. 1).

Edamame injury June 27, 2011 (10 DAT of postemergence treatments) averaged 6% for Raptor or Basagran applied alone and 3% for Raptor plus Basagran tank mix across all edamame cultivars (Fig. 5). Previous reports with other legume crops have shown that Basagran tank mixed with Raptor often reduces injury. Interestingly, only Sayakomachi cultivar had no injury in all four replications following Basagran alone treatment.

By July 6 edamame injury was greatest with the three treatments containing Prowl preemergence but there was no significant cultivar by herbicide interaction. Postemergence treatments of Raptor, Basagran, or Raptor plus Basagran caused only very minor injury. Edamame injury was greater on July 11, 2011 and there was a significant herbicide by cultivar interaction on edamame injury (Fig. 2). Injury was greatest with Prowl alone or Prowl tank mixes on AGS-292 and WSU 910A cultivars (Fig. 2).

Both herbicide treatment and edamame cultivar affected final stand count August 23, 2011, but there was not a significant herbicide by cultivar interaction on final stand count. Prowl applied preemergence alone or in tank mixes with Reflex or Spartan reduced final stand counts in August causing plants with brittle stems that sometimes broke off at the soil line. Lodged plants from Prowl injury were most

noticeable in cultivars AGS-292 and WSU-910A. Reflex and Spartan tank mixed with Prowl did not increase edamame injury compared Prowl applied alone.

Edamame height on August 23, 2011 was affected by both herbicide and cultivar, but there was not a significant herbicide by cultivar interaction. Hand weeded checks averaged the tallest (27 inches) across all cultivars, whereas postemergence treatments of Raptor averaged the least (22.5 inches) (Fig 7). WSU 729 and Midori Giant were the tallest cultivars, averaging 27 inches across all herbicide treatments, whereas WSU 910A was the shortest cultivar averaging 22 inches (Fig. 8).

Both herbicide treatment and cultivar significantly affected final pod yield and there was not a significant herbicide by cultivar interaction. Weedy checks (hand weeded from July 7 until harvest) yielded the least (2.6 ton/a) probably due to early season weed competition from common lambsquarters and annual grasses. Although Prowl treatments injured edamame and reduced stands in several cultivars, pod yield averaged only slightly less and was statistically similar to other preemergence herbicide treatments. Highest pod yields were obtained from treatments of Dual applied preemergence followed by Raptor plus Basagran, averaging 3.4 ton/a.

Midori Giant cultivar averaged the greatest pod yields (4.2 ton/a) followed by AGS 292 and Sayakomachi, 3.6 and 3.4 ton/acre, respectively (Fig. 9). WSU 910A cultivar matured the latest, was harvested last, and yielded the lowest (2.5 ton/a). The percentage of one-, two-, three-, and four-seeded pods was similar among cultivars with the exception of WSU 729, which had a higher percentage of 3- and 4-seeded pods than all other cultivars (Fig. 10). WSU 910A also had a slightly higher percentage of 3-seeded pods than the other four cultivars (Fig. 10).

Conclusions.

All herbicide treatments tested in this trial were safe on all six edamame cultivars with the exception of two cultivars (WSU 910A and AGS 292) showing slightly greater sensitivity to Prowl. It appears that Prowl has the possibility of causing injury (brittle stems) under certain situations with specific cultivars, although it did not significantly reduce pod yields compared to other preemergence herbicide treatments. Dual, Reflex, and Spartan applied preemergence caused very little or no injury to the six edamame cultivars tested and controlled most weeds well. Raptor, Basagran, and tank mixes of Raptor plus Basagran applied postemergence controlled weeds well and resulted in only minor injury to edamame.

All edamame cultivars developed harvestable pods during what was a cooler than normal growing season and appear to be suitable for production in the PNW. WSU 729 was a unique cultivar with narrow leaves and indeterminate flowering and was the only cultivar that produced 4-seeded pods. Japanese cultivars, Sayakomachi and Sayamusume, matured earlier and could be useful cultivars especially in situations where planting date is delayed and growers are working with a shorter than normal season. Midori Giant was intermediate in maturity compared to the other cultivars tested and yielded the greatest. Yield of various cultivars could have possibly been influenced by slightly less than optimum harvest dates although each cultivar was harvested as close as possible to what was considered optimum.

Basagran registration in edamame is in progress. Raptor registration in edamame could be accomplished with existing residue data if BASF agrees to add it to the label. A petition for tolerance for pendimethalin (Prowl H20) in edamame has been submitted to the EPA. Additional residue data is required to establish a tolerance for fomesafen (Reflex), ethalfluralin (Sonalan), and sulfentrazone (Spartan). There is currently an active IR-4 project for Spartan on edamame.

Acknowledgments

Chris Knudson, Twin City Foods. Mike Watkins, Seneca. Dennis McMillan, NorPac. Randy Tastad, National Frozen Foods. Ron Whittum, Washington Crop Improvement. Mary Jo Wannamaker, Wannamaker Seeds. Pacific Northwest Vegetable Association. Washington State Commission on Pesticide Registration

Table 1. Herbicide treatments tested on edamame near Prosser, WA in 2011.

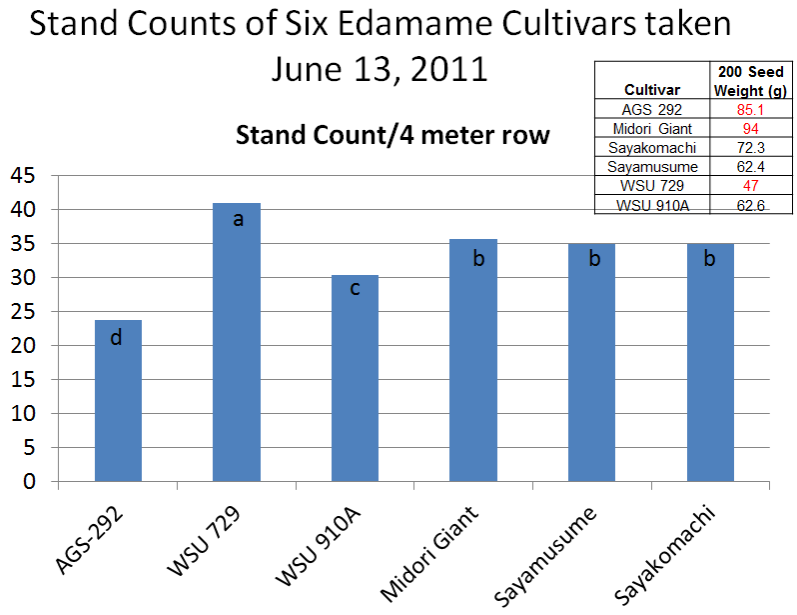
1.	Prowl	0.95 lb ai/a
2.	Prowl + Reflex	0.95 + 0.25 lb ai/a
3.	Prowl + Spartan	0.95 + 0.19 lb ai/a
4.	Dual Magnum	1.4 lb ai/a
5.	Dual Magnum +Reflex	1.4 + 0.25 lb ai/a
6.	Dual Magnum + Spartan	1.4 + 0.25 lb ai/a
7.	Sonalan HPB + Dual Magnum	0.75 + 1.4 lb ai/a
8.	Dual pre fb Raptor	1.4 / 0.0313 lb ai/a
9.	Dual pre fb Basagran	1.4 / 1 lb ai/a
10.	Dual pre fb Raptor + Basagran	1.4 / 0.0313 + 1 lb ai/a
11.	Weedy check	
12.	Hand-weeded check	

Table 2. Flowering notes, pod development, GDD, days to harvest, and harvest dates of six edamame cultivars at Prosser, WA in 2011.

Edamame Cultivar	7/20/11 Flowering	8/5/11 Pod length (in.)	8/10/11 Pod length (in.)	GDD to Harvest[1]	Days from Planting to Harvest	Harvest Date(s)
Sayakomachi	90%	1-2	2	1390-1460	94-98	8/25-8/29
Sayamusumi	75%	0.5 - 1	1.5-2	1390-1460	94-98	8/25-8/29
Midori Giant	30%	0.5 - 1	0.5 – 1.5	1500	100	8/31
AGS 29-2	30%	0.5	0.5 - 1	1500-1525	100-101	8/31-9/1
WSU-729	20%	0.25-0.5	0.25 – 0.75	1650	106	9/7
WSU-910A	5%	0.25	0.25 – 0.5	1750	109	9/12

[1]GDD – base 50 from emergence date of June 2, 2011.

Figure 1.



Herbicide treatment had no significant effect on stand counts June 13

Figure 2.

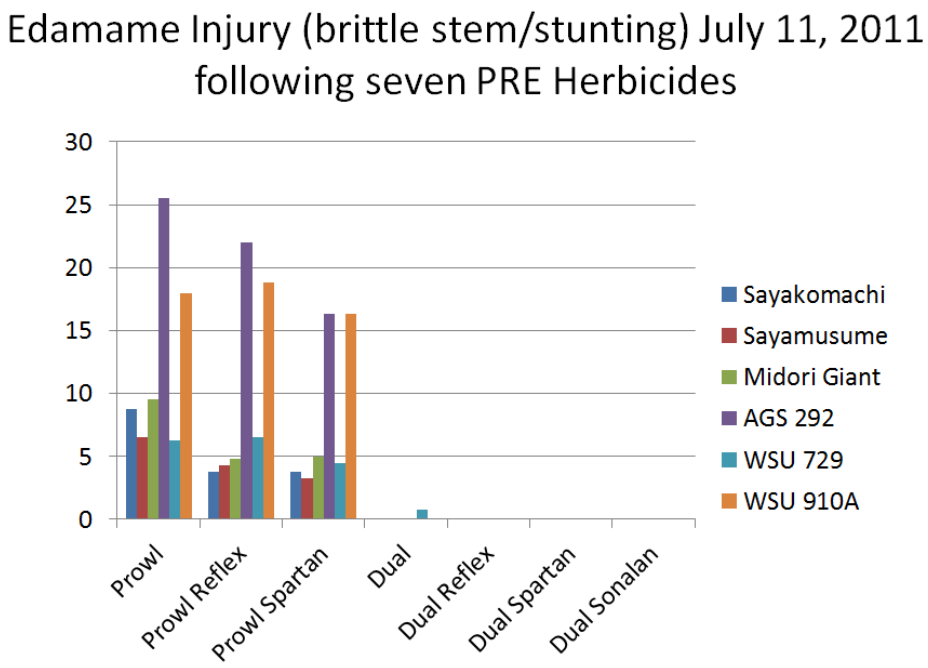


Figure 3.

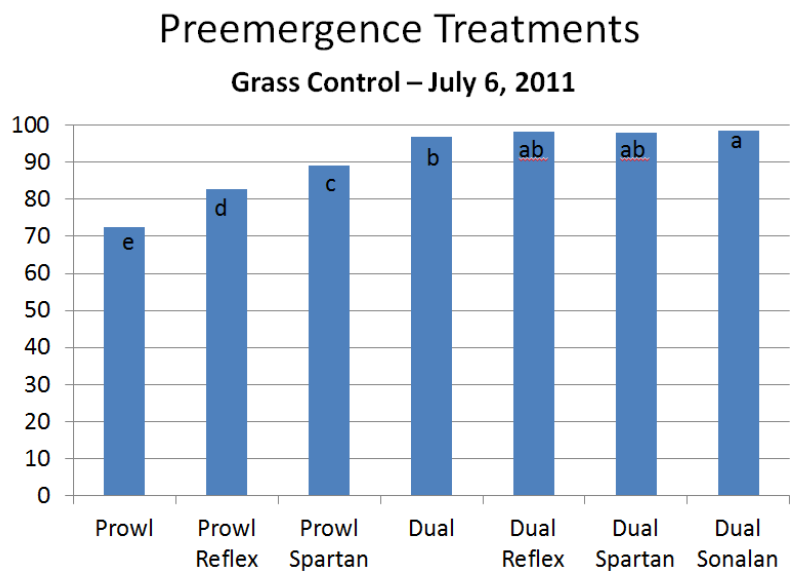


Figure 4.

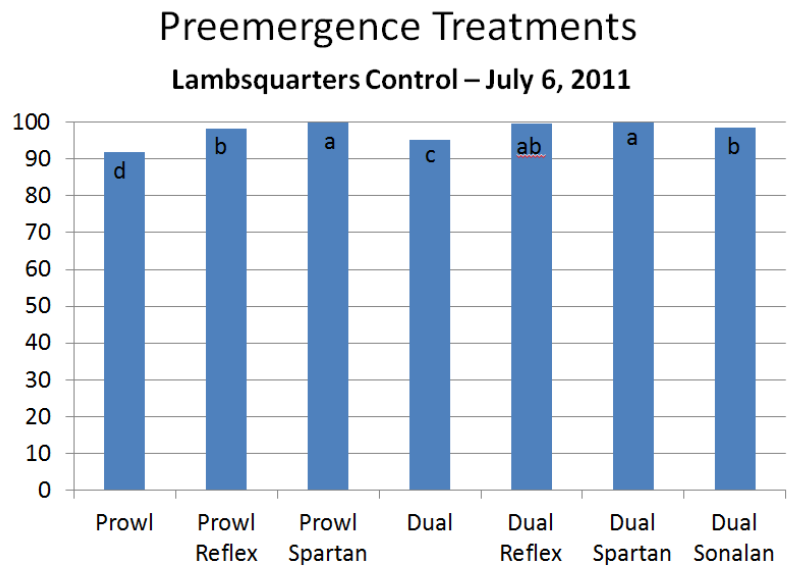
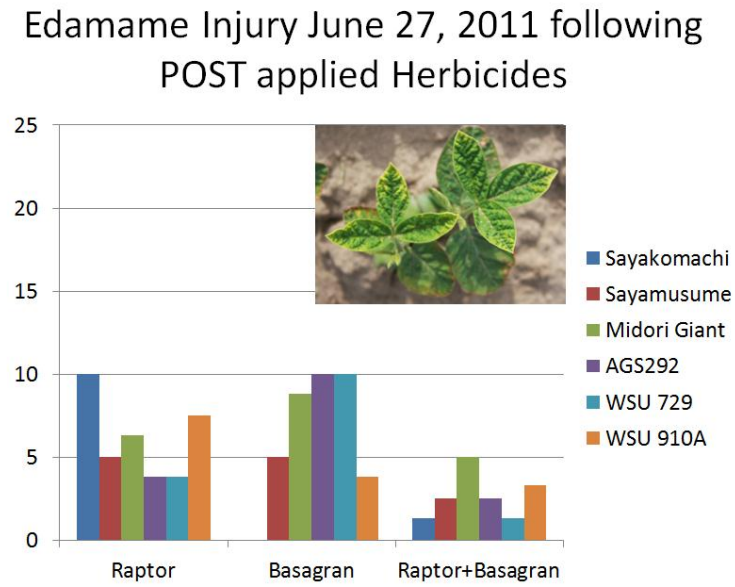


Figure 5.



Only minor injury with POST herbicides and the combination lessoned injury

Figure 6.

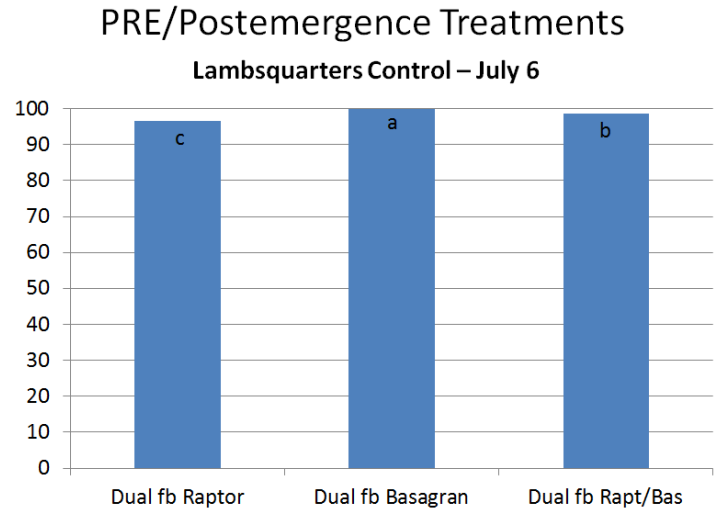


Figure 7.

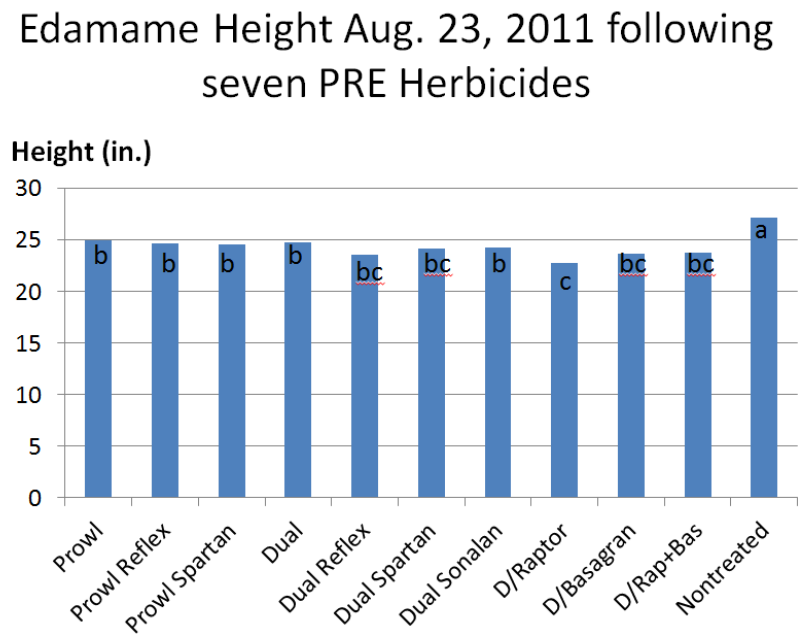


Figure 8.

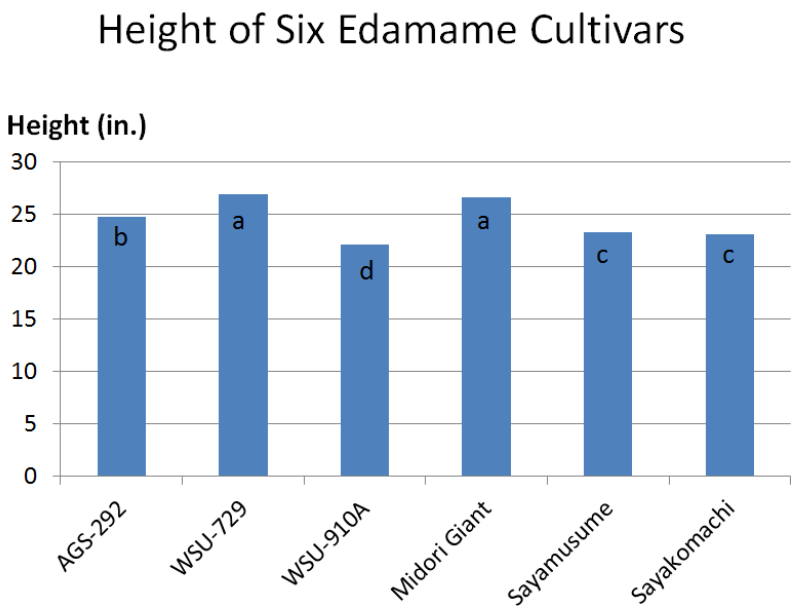
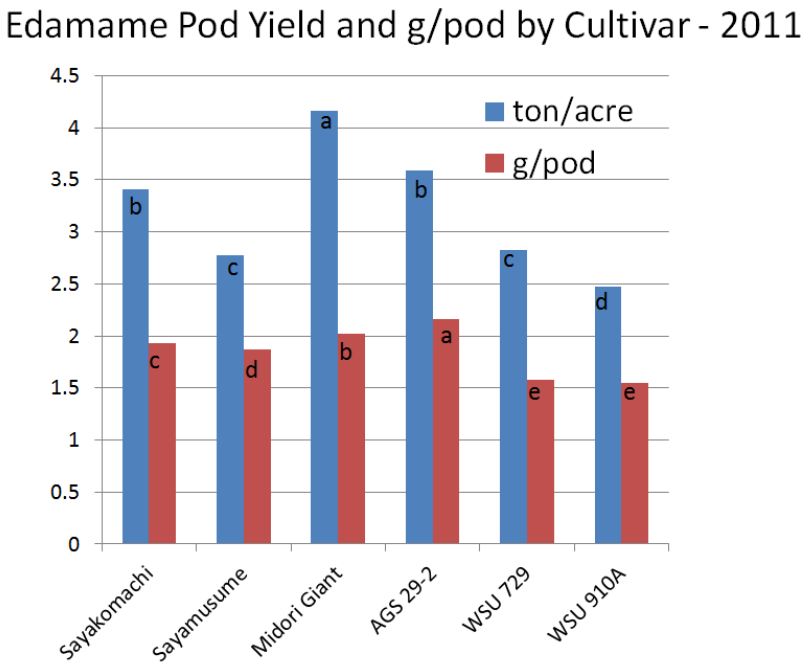
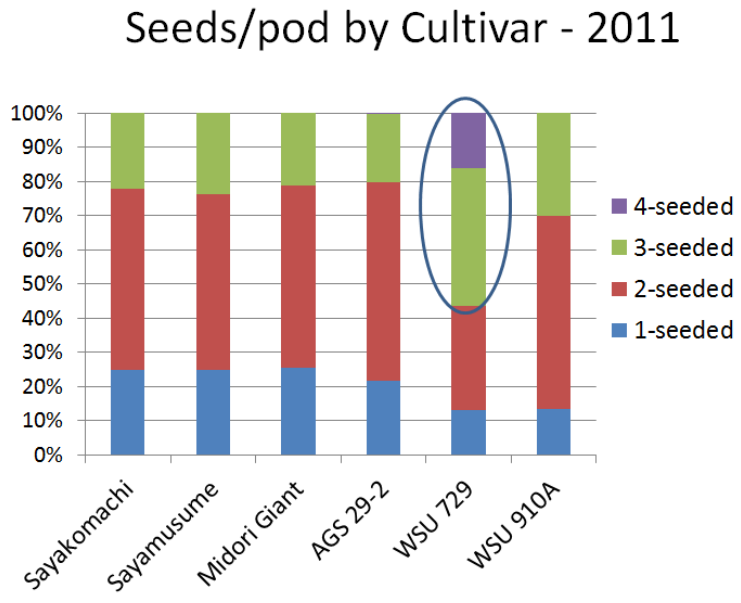


Figure 9.



Herbicide treatments had no significant effect on pod yield

Figure 10.



Herbicide treatments had no effect on seeds/pod